IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Kazuyoshi Inoue et al. Examiner: Michael A. Band

Serial No.: 10/594,756 Group Art Unit: 1795

Filed: September 29, 2006 Confirmation No.: 4694

Title: INDIUM OXIDE-CERIUM OXIDE BASED SPUTTERING TARGET, TRANSPARENT
ELECTROCONDUCTIVE FILM, AND PROCESS FOR PRODUCING A TRANSPARENT
ELECTROCONDUCTIVE FILM

APPEAL BRIEF

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Commissioner for Patents
P.O. Box 1450
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Sir:

Further to the Notice of Appeal filed on February 7, 2011, please consider the following.

The Appeal Brief fee of $ 540.00 is filed/paid herewith. The Commissioner is hereby authorized to charge any fees associated with this response or credit any overpayment to Deposit Account No. 13-3402.

(i) REAL PARTY IN INTEREST

The present application is assigned to Idemitsu Kosan Co., Ltd., by means of an Assignment filed at Reel 018399, Frame 0553 on September 29, 2006.

(ii) RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences.

(iii) STATUS OF CLAIMS

Claims 1-4 are pending, and are on Appeal. Claim 5 has been cancelled. Claims 6-9 are withdrawn.

(iv) STATUS OF AMENDMENTS

Appellants' Amendment filed January 24, 2011, has been entered. See the Advisory Action of February 7, 2011, item No. 7.

(v) SUMMARY OF CLAIMED SUBJECT MATTER

The present invention is directed, in claim 1, to a sputtering target comprising indium oxide and positive trivalent cerium oxide, wherein [Ce]/([In] + [Ce]) = 0.005 to 0.035 wherein [Ce] represents the number of the atoms of cerium per unit weight/unit mass, and [In] represents the number of the atoms of indium per unit weight/unit mass, and wherein the abundance of trivalent cerium $[Ce^{+3}]/([Ce^{+3}] + [Ce^{+4}])$ is 0.01 to 0.6,wherein when its crystal peaks are observed by X-ray diffraction, the presence of peaks originating from indium oxide and cerium oxide is observed, and further when EPMA measurement is performed, the measured diameter of particles of cerium oxide dispersed in indium oxide is 5 μm or less. See the specification at paragraphs 21, 26, 27, 31, 33, 62, 69 and 77.

(vi) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The grounds of rejection to be reviewed on appeal are the rejection of claims 1-4 under 35 USC §112, first paragraph and the rejection of claims 1-4 under 35 USC §103.

(vii) ARGUMENT

Rejection Under 35 USC §112:

Claims 1-4 have been rejected under 35 USC §112, first paragraph, as failing to comply with the written description requirement for two reasons. First, it is argued that the recitation "the abundance of trivalent cerium, $[Ce+^{3}]/([Ce+^{3}]+[Ce+^{4}])$ is 0.01 to 0.6," is unsupported. Second, it is argued that the recitation "[Ce]/([In]+[Ce]) = 0.005 to 0.035" is also unsupported in the Specification. For the reasons discussed below, Appellants respectfully disagree.

First, it is argued, for example at page 2 of the Final Rejection, that the recitation of the "abundance of trivalent cerium," expressed as "[Ce+3]/([Ce+3]+[Ce+4])," and recited as 0.01 to 0.6, finds no support "to determine the abundance of trivalent cerium" in the specification. This assertion is clearly in error. Paragraph 33 of the present specification states that the "abundance (presence ratio) of the trivalent cerium is preferably from 0.01 to 0.6." Paragraph 62, which, as admitted at page 2 of the specification teaches that the abundance of trivalent cerium produced in one example has a value of 0.15, defines the abundance of cerium as "abundance of the positive trivalent cerium, that is, [Ce+3]/([Ce+3] + [Ce+4]), which was obtained from peak separating treatment and area ratio, was 0.15. Herein, [Ce+3] represents the number of the trivalent cerium atoms per unit volume/unit mass in the sample, and [Ce+4] represents the number of the positive quadrivalent cerium atoms in the same unit." Thus, the specification clearly supports the definition of the "abundance of trivalent cerium" as the amount of Ce+3 divided by the total amount of Ce+3 and Ce+4. Moreover, these two paragraphs further explicitly support the ratio of 0.01 to 0.6 for the "abundance of trivalent cerium."

However, the Advisory Action of February 7, 2011, argues that:

> "abundance of trivalent cerium is between 0.01 to 0.6, whereas para 0062 states that positive trivalent cerium using the expression [Ce+3]/([Ce+3]+[Ce+4]) is 0.15, thus the expression relates to only positive trivalent cerium."

This is respectfully submitted to be an interpretation that flies in the face of the plain meaning in the specification and does not make sense. It appears, perhaps, that the Advisory Action intends to state that the "abundance of trivalent cerium" in paragraph 33 refers, perhaps, to the ratio of cerium to indium, and not to Ce^3+/(Ce^{3+} + Ce^{4+}). However, paragraph 26, which refers to the ratio of cerium to the total of indium plus cerium, is clearly not linked to paragraph 33, reciting the "abundance of trivalent cerium." Indeed, it is clear from the table in Fig. 1 that the amount of cerium versus indium (see the third row from the top) is distinct from the abundance of trivalent cerium in the last column at the bottom of Fig. 1, with the numerical values of each corresponding to the relevant paragraphs in the specification. The specification uses the term "abundance of cerium" in paragraph 33, and "abundance of positive trivalent cerium" in paragraph 62, and it is clear that these expressions are intended to define the same parameters. Wherever the amount of cerium versus the

amount of indium is used, it is referred to as a ratio, or with the expression having cerium in the numerator and indium in the denominator. In order to clarify these disclosures, attention is directed to the following table:

Claim: abundance of positive trivalent cerium: 0.01-0.6 ($[Ce^{3+}]/([Ce^{3+}] + [Ce^{4+}])$

Paragraph 33: abundance of trivalent cerium: 0.01-0.6, 0.01-0.4, 0.05-0.4

Paragraph 62: abundance of positive trivalent cerium: $([Ce^{3+}]/([Ce^{3+}]+[Ce^{4+}])=0.15$

Fig. 1: abundance of trivalent cerium 0.15, 0.24, 0.36

Paragraph 26: ([Ce]/[In] + [Ce]) = 0.005 - 0.15

Paragraph 27: (Refers to "this expression") 0.005, 0.15, 0.01 - 0.1, 0.01-0.05

Paragraph 66: "the ratio between the number of cerium atoms and that of indium atoms ((the number of cerium atoms)/(that of indium atoms))

Fig. 1: [Ce]/[In] 0.012, 0.35, 0.07 (0.0005, 0.18 are comparative examples)

It is submitted to be clear that paragraph 26, referring to the ratio cerium to indium, does not refer to the amount of *trivalent* cerium but to all cerium. The values for the "abundance of trivalent cerium" in Fig. 1 are within the range for the equation $Ce^{3+}/Ce^{3+} + Ce^{4+}$ but outside the range given for the "ratio of cerium to indium" in paragraph 26. It is therefore accordingly submitted that ample written description exists to support the claim recitation of the abundance of "positive trivalent cerium" being 0.01 to 0.6. Ample basis to overturn this rejection exists, and the same is respectfully requested.

It is further argued, for example in the Advisory Action, that paragraphs 26-28 of the specification teaching the ratio of cerium to indium of 0.005 to 0.15, does not support the narrowed range of 0.005 to 0.035. It is noted that the Examiner find support, however, for narrowed ranges compiled from the examples. However, it is clearly not necessary to provide explicit support, nor exemplarly support, for a narrowed numerical range, in view of well established case law. For example, the Federal Circuit's predecessor court has stated that satisfaction of the written description requirement of §112 is evaluated from the perspective of one ordinary skill in the art and that it is quite clear that "ipsis verbis" description is not required. All that is necessary for written description is that a specification convey to one of ordinary skill in the art that the Applicant has invented the specific subject matter later claimed. *In re Smith*, 481 2d. 910, 178 U.S.P.Q. 620 (CCPA 1973).

In the area of numerical ranges, the case law is quite clear that where a broad numerical range is disclosed, Applicants have invented the entirety of the range and have full written description to claim a narrow portion thereof, *even where* a specific end point is not explicitely disclosed. See *In re Wertheim et al.*, 541 F2d. 257, 191 U.S.P.Q. 90 (CCPA 1976). In *Wertheim*, there was original disclosure of a range of 25-60, with additional example data points at 36 and 50. Applicants wished to claim a range of 35 to 60, with the point of 35 being nowhere disclosed in the specification. In holding that the broad range of 25-60 supported at this narrow range of 35-60, the court held that one of ordinary skill in the art viewing the broad range would envision the narrower range later claimed. It is noted that *Wertheim* had an example close to the value which formed the end terminus of the later claimed range. However, it is important to note that this is not necessary under the doctrine of *Wertheim*. Indeed, in *McLaughlin v. Roberts*, 197 USPQ 831 (POBI 1978); Roberts claimed an amount of propellant in a composition of 10 to 25%. Roberts' specification disclosed amounts of 10 to 79%, 40 to 79%, and 40 to 60%. Thus, the 25% value was not explicitly disclosed and, moreover, outside of the preferred range. However, applying the *Wertheim* rationale, the Patent Office own Board of Interferences held that one of ordinary skill in the art would envision the narrowly claimed range, stating that one of ordinary skill in the art "would consider that the use of the 10-25% range would be a part of [Roberts] invention." 197 USPQ at 835.

It is thus amply clear that the narrowed range of 0.005 to 0.035 finds written description in the broad range of 0.005 to 0.15, and that this rejection should also be overturned.

Rejection Under 35 USC §103:

Claims 1-4 have been rejected under 35 USC §103 over Fukuyoshi (JP'841) and Hosokawa et al. (WO '137). Reconsideration of this rejection is again respectfully requested. As admitted in the Office Action, both Fukuyoshi and Hosokawa are silent on the abundance of trivalent cerium, that is, the ratio of cerium +3 to +4. Claim 1 recites an abundance ratio of 0.01-0.6. To the extent that Hosokawa arguably "recognized the equivalency" of various cerium oxides, as argued at page 4 of the office action, Hosokawa does not, however, suggest any particular ratio of the trivalent to quadravalent ions. Merely disclosing CeO_2 and CeO_x in a larger list that concludes with "and mixtures" does not suggest to one of ordinary skill the

particularly claimed ratio of just these two oxides, in admixture. Moreover, it is not seen that the particular claimed ratio herein is "merely the selection of a functionally equivalent cerium oxides recognized in the art." Indeed, the abundance of trivalent cerium is not recognized as a result effective variable in sputtering, but Applicants herein have determined that if the abundance is less than 0.01 then the dispersability of the cerium atoms may not be controlled with ease. Applicants have further determined that, if the abundance is more that 0.6, abnormal dispersion may be caused. See paragraph 33 of the present specification. In addition, in comparative examples 1-3 of the present specification, no trivalent cerium was present. There was a failure of crystallization in these examples, unacceptable high electrode potential and, in two examples, unacceptable specific resistance. This is shown to be true verses examples with varying levels of trivalent cerium. Thus, the present sputtering targets having an abundance of trivalent cerium as stated are clearly advantageous, and the rationale in the Office Action, that the trivalent or tetravalent forms of cerium are "functionally equivalent," is disproved.

In addition, the references fail to suggest a ratio of cerium to indium of 0.005 to 0.35. Assuming that the calculation performed at page 5 of the Office Action is correct (which is not admitted) the prior art enables calculation of a ratio 0.05, outside of the presently claimed range. While it is argued that the presently claimed range of 0.035 is "close enough that one skilled in the art would have expected them to have the same properties" no basis for this assumption is given, and it is submitted that none exists. At page 6, the Office Action appears to call for evidence that such concentration is "critical." In the absence of motivation to modify the ratio, it is submitted that such evidence is not necessary. However, as demonstrated in the present examples, with increasing ratio the particle diameter increases, eventually to an undesirable point. This can be seen by comparing, for example, examples 1 and 2 with example 3, when a ratio of 0.07 produces a particle diameter nearly double that of the other two examples. Thus, by controlling the ratio, one of ordinary skill in the art in view of the present specification is able to maintain an advantageous particle diameter. This is not taught in the reference, and it is submitted it provides further basis of patentability.

Reversal of the rejection is therefore mandated by law, and is respectfully and courteously requested.

Respectfully submitted,
/Harry B. Shubin/
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Harry B. Shubin (Reg. No. 32,004)
Attorney for Applicant(s)

MILLEN, WHITE, ZELANO
& BRANIGAN, P.C.
Arlington Courthouse Plaza 1, Suite 1400
2200 Clarendon Boulevard
Arlington, Virginia 22201
Telephone: (703) 243-6333
Facsimile: (703) 243-6410

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(viii) CLAIMS APPENDIX

1. A sputtering target comprising indium oxide and positive trivalent cerium oxide, wherein $[Ce]/([In] + [Ce]) = 0.005$ to 0.035 wherein [Ce] represents the number of the atoms of cerium per unit weight/unit mass, and [In] represents the number of the atoms of indium per unit weight/unit mass, and wherein the abundance of trivalent cerium $[Ce^{+3}]/([Ce^{+3}] + [Ce^{+4}])$ is 0.01 to 0.6,wherein when its crystal peaks are observed by X-ray diffraction, the presence of peaks originating from indium oxide and cerium oxide is observed, and

further when EPMA measurement is performed, the measured diameter of particles of cerium oxide dispersed in indium oxide is 5 μm or less.

2. The sputtering target according to claim 1, wherein when the EPMA measurement is performed, the presence of the cerium oxide particles, which are cerium oxide particles, dispersed in indium oxide and having a diameter of 1 μm or more is observed.

4. The sputtering target according to claim 1, comprising indium oxide and cerium oxide, and having a density of 6.6 g/cc or more and a bulk resistance of 1 mΩcm or less.

6. A transparent electroconductive film formed by sputtering using the sputtering target according to claim 1, the specific resistance of the film being less than 600 μΩcm.

7. The transparent electroconductive film according to claim 6, which is heated in a temperature range of 200 to 250°C, so as to be crystallized.

8. The transparent electroconductive film according to claim 6, wherein the standard electrode potential to Ag/AgCl is 0.6 V or less.

9. A process for producing a transparent electroconductive film by use of the sputtering target according to claim 1,

comprising the step of using the sputtering target according to any one of claims 1 to 5 to form the transparent electroconductive film by sputtering, and

the step of heating the formed transparent electroconductive film in a temperature range of 200 to 250°C, thereby crystallizing the film.

(ix) EVIDENCE APPENDIX

None

(x) RELATED PROCEEDINGS APPENDIX

None